

Remarks

The Subject Application presently includes claims 1-59. In the Office Action, which is non-final, the Examiner rejects claims 1-4, 6-25, 27-35, 37-52 and 54-59 under 35 U.S.C. § 103(a) as being anticipated by U.S. Patent No. 5,368,630 issued to Luk ("Luk"). The Examiner contends that Luk discloses the method of the invention substantially as claimed. In particular, the Examiner asserts that Luk discloses a method of forming a powder metal part that includes providing a metal powder comprising sponge iron, compacting the metal powder at 5-200 tsi to form a green compact, and sintering the green compact to form a powder metal part.

Also, in the Office Action The Examiner rejects claims 5, 26, 36 and 53 under 35 U.S.C. § 103(a) as having been obvious over Luk in view of U.S. Patent No. 4,720,615 to Dunn ("Dunn"). The Examiner contends that Luk discloses the invention substantially as claimed, but does not disclose the specific type of sintering to be used. The Examiner points to Dunn as teaching the use of induction sintering in the same field. The Examiner concludes that it would have been obvious to one having ordinary skill in the art to have modified the method taught in Luk to use the induction sintering method taught in Dunn.

In the present Amendment, Applicants amend claims 1, 52 and 59, cancels claims 6, 12-51 and 54-58 and presents new claims 60-67. The Subject Application now includes claims 1-5, 7-11, 52, 53, 59 and 60-67. Claims 1, 52 and are the independent claims.

Claim 1 of the Subject Application recites a method of forming a powder metal material that includes compressing at least a portion of an iron-containing metallurgical powder in a die at no greater than 20 tsi to provide a green compact, and sintering the compact. As amended herein, claim 1 recites that the iron-containing metallurgical powder comprises sponge iron and is “substantially free of internal lubricant”. As explained in the Subject Application, the inventors have determined that including some portion of sponge iron in the metallurgical powder allows the powder to be compacted at a molding pressure no greater than 20 tsi to provide a green compact having sufficient green strength to be handled. See, e.g., Subject Application at page 16, line 21 to page 17, line 23. Use of relatively low compaction pressures allows the metallurgical powder to include little or no internal lubricant without occurrence of unacceptable die wear during compaction. See *id.* Excluding or minimizing internal lubricant provides distinct advantages, including improving thermal and electrical coupling between the powder particles and reducing the risk of part fracture due to internal stresses generated by trapped gases liberated during sintering. See, e.g., page 12, lines 5-14

In contrast to claim 1 of the Subject Application, Luk provides metal powder compositions that are specifically formulated to include internal lubricant. For example, Luk states that it is directed to “a binder-containing lubricated, metal powder composition that can be compacted at elevated temperatures.” Col. 2, lines 42-44 (emphasis added). Luk also variously states, for example:

The compositions contain an iron-based metal powder, a minor amount of at least one alloying powder, a high temperature

compaction lubricant for facilitating compaction of the powder composition at elevated compaction temperatures without causing excessive die wear, and an organic binder for the iron-based alloying powders.

Col. 2, lines 42-50 ("Summary of the Invention").

The metal powder compositions that are the subject of the present invention also contain a high temperature compaction lubricant. This lubricant is functionally defined as a powder metallurgy lubricant that can withstand the elevated compaction temperatures associated with warm compaction techniques.

Col. 4, lines 59-64. In addition, Luk's three independent claims, claims 1, 17 and 29, each specifically recites a metallurgical powder composition including, *inter alia*, a "high temperature compaction lubricant" (claim 1) or a "polyamide lubricant" (claims 17 and 29).

Accordingly, Luk specifically teaches that the metal powder compositions of the patent must include an internal lubricant, which is intended to facilitate compaction of the powder at elevated compaction temperatures while inhibiting excessive die wear. Luk does not teach or in any way suggest providing an iron-containing metallurgical powder that is substantially free of internal lubricant, as is recited in independent claims 1 and 52 of the Subject Application.

Indeed, Luk actually teaches away from using a metallurgical powder lacking internal lubricant. As quoted above, Luk provides an internal lubricant within its powder compositions as a means to inhibit die wear under the warm compaction conditions utilized in the methods of Luk. It is reasonable to

conclude that one of ordinary skill relying on the teachings of Luk would seek to avoid undesirable die wear and would, therefore, include an internal lubricant.

Accordingly, Luk does not disclose or in any way suggest the methods recited in either of claims 1 and 52, as amended herein. In addition, none of the remaining references of record in the Subject Application would have suggested modifying the method taught in Luk to exclude substantially all internal lubricant from the metallurgical powder disclosed in Luk.

Thus, the rejection of claims 1 and 52 over Luk should be withdrawn, and the claims should be passed to allowance. Each of dependent claims 2-5, 7-11, 53 and 59-61 ultimately depend from one of claims 1 and 52. Given that claims 1 and 52 are patentable over the cited references, it follows that dependent claims 2-5, 7-11, 53 and 59-61 also are patentable and should be passed to allowance.

New claim 63 recites a method of forming a powder metal material wherein the method includes compressing at least a portion of an iron-containing metallurgical powder comprising sponge iron in unheated die at no greater than 20 tsi to provide a green compact, and sintering the compact.

In contrast, Luk is specifically directed to the use of warm compaction to provide a green compact from a metallurgical powder. For example, Luk describes the invention it discloses as relating to:

... metal powder compositions containing a lubricant for high temperature compaction and a binding agent to reduce dusting and segregation. The invention further relates to methods of

compacting the metal powder compositions at elevated temperatures to make sintered components.

Col. 1, lines 7-12 (emphases added). Luk further variously states that:

- it “provides methods of making a sintered metal part that includes compacting the powder compositions in a die at a temperature of from about 100°C to about 370°C” (col. 2, line 66 to col. 3, line 2);
- the internal lubricant included in the metallurgical powder is “a powder metallurgy lubricant that can withstand the elevated compaction temperatures associated with warm compaction techniques. These temperatures generally range from about 100°C (212°C) up to about 370°C (700°F).” (col. 4, lines 62-66); and
- “The metal powder compositions containing the iron-based metal powder, alloying powders, the lubricant, and the binding agent, as above described, is compacted in a dye according to standard metallurgical techniques at ‘warm’ temperatures as understood in the metallurgy arts” (col. 8, lines 4-9).

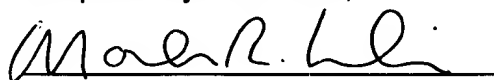
Claim 63 recites that the iron-containing metallurgical powder is compressed in an unheated die to provide the green compact. This aspect of the claimed invention clearly is neither disclosed nor suggested by Luk, which, instead, teaches the use of warm compaction. Accordingly, new claim 63 is directed to patentable subject matter and should be passed to allowance. Claim 64-67 depend from claim 63 and, therefore, also are patentable and should be passed to allowance.

Conclusion

It is respectfully submitted that each of claims 1-5, 7-11, 52, 53 and 59-67 as presented herein is patentable relative to the references of record.

Accordingly, Applicants earnestly solicit issuance of a Notice of Allowance for each of the claims at an early date. If, instead, the Examiner has any concerns regarding the claims herein, Applicants request that he contact the undersigned by phone so that those concerns can be addressed expeditiously.

Respectfully submitted,



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